

Electric Current

Electric current is the *rate* of movement of electric charge. As an equation,

$$I = \frac{q}{t}$$

→ q is the charge, measured in coulombs (C)
 → I is the current measured in amperes, or amps (A),
 where one ampere = one coulomb/sec

Example #1: A 10 ampere current flows through a wire in 60 seconds.

Determine:

- The amount of charge that moves in 60 seconds.
- The number of electrons that pass in 60 seconds.

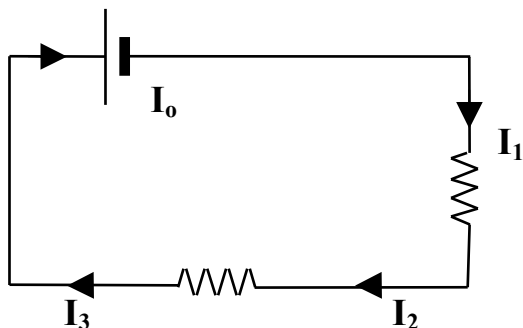
(see Circuitry Ex 1 for answer)

Example #2: If a current of 5.0 A flows for 20 minutes, what charge was transferred?

(see Circuitry Ex 2 for answer)

Kirchhoff's Current Law

It was German physicist Gustav Robert Kirchhoff who first determined that electrons are conserved. Since electrons have only one path to travel in a series circuit, electric current at all points remains the same.

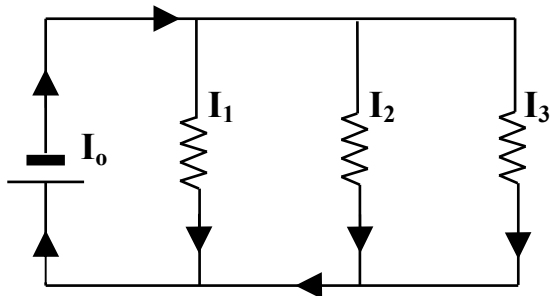


$$I_0 = I_1 = I_2 = I_3$$

where I_0 = the total current in the circuit,
as produced by the battery

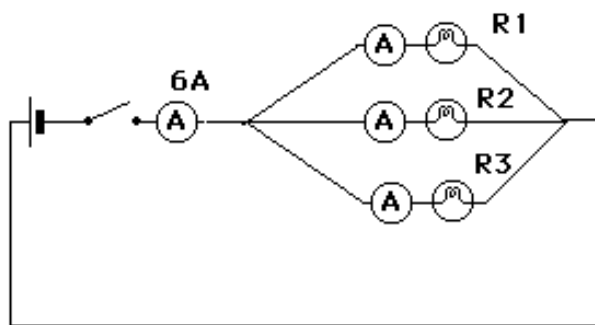
To measure current properly, an *ammeter* must be placed in series into the circuit. For the above circuit, the device can be placed anywhere along the path, and will display the same current reading, regardless of its location.

On the other hand, at a parallel connection, the total current flowing into the connection must equal the sum of the currents flowing out of the connection.



$$I_0 = I_1 + I_2 + I_3$$

Note that when all resistors are equal, current is divided equally through the different paths. Examine the diagram below.



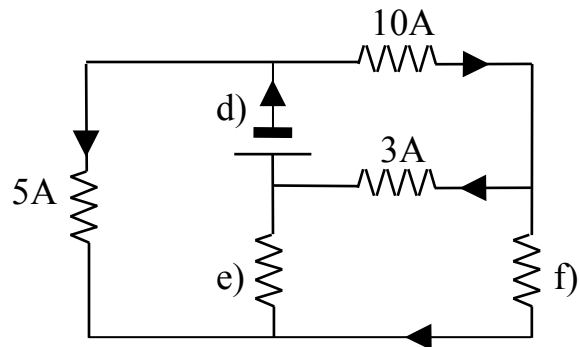
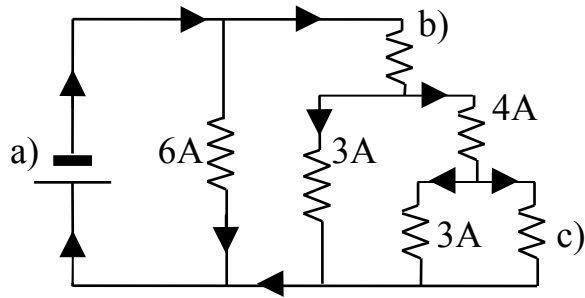
An ammeter placed by the battery will display the total current, which in this case is 6 A. An ammeter placed along any parallel path (in series with the device in that path) will only display the current through that path.

If all the lamps have the same resistance in the above circuit, then each of the three ammeters placed in the parallel branches will display a current of 2 A (2 + 2 + 2 = 6 A).

If the resistors in the diagram are not equal, then other methods can be used (later). Always keep in mind, though that *less* resistance means a *greater* flow of electrons.

From this, *Kirchhoff's Current Law* was developed: At any connection in an electric circuit, the total current into a connection must equal the total current out of that connection.

Example #3: Determine the unknown currents for each of the following circuits.



(see Circuitry Ex 3 for answer)